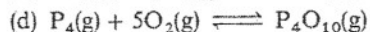
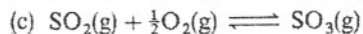
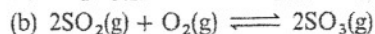


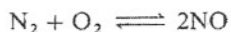
## PROBLEMS

### Gas Phase Equilibria

1. What are the equilibrium constant expressions  $K_c$  and  $K_p$ , for each of the following reactions?



2. The reaction of nitrogen with oxygen to give nitrogen monoxide,



has an equilibrium constant of  $2.5 \times 10^{-3}$  at  $2100^\circ\text{C}$ .

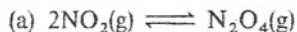
(a) What is the expression for the equilibrium constant?

(b) What are the units of the equilibrium constant?

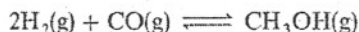
3. The equilibrium constant for the equilibrium



at  $100^\circ\text{C}$  is  $0.212 \text{ mol L}^{-1}$ . What is the value of the equilibrium constant for the same reaction written as follows?

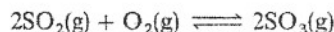


4. At  $425^\circ\text{C}$ ,  $K_c = 300 \text{ mol}^{-2} \text{ L}^2$  for the reaction in which methanol,  $\text{CH}_3\text{OH}$ , is synthesized from hydrogen and carbon monoxide:



If the initial concentrations of  $\text{H}_2$ ,  $\text{CO}$ , and  $\text{CH}_3\text{OH}$  are  $0.10 \text{ mol L}^{-1}$ , is the system at equilibrium?

5. When the reaction



had reached equilibrium, the concentrations of the reactants

and the products were found to be  $[\text{SO}_2] = 0.010 \text{ M}$ ,  $[\text{SO}_3] = 0.100 \text{ M}$ , and  $[\text{O}_2] = 0.20 \text{ M}$ . What is the value of  $K_c$ ?

6. Dinitrogen tetraoxide dissociates to nitrogen dioxide according to the equation



In a mixture of the two gases at  $100^\circ\text{C}$  the concentrations were found to be  $[\text{N}_2\text{O}_4] = 0.10 \text{ M}$  and  $[\text{NO}_2] = 0.12 \text{ M}$ .

(a) What is the value for the reaction quotient of the mixture?

(b) Given that  $K_c = 0.212 \text{ mol L}^{-1}$  at  $100^\circ\text{C}$ , is the system at equilibrium?

(c) If not, will  $[\text{NO}_2]$  increase or decrease as equilibrium is achieved?

(d) What are the final equilibrium concentrations of  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$ ? What is the value of  $K_p$  at  $100^\circ\text{C}$  for this reaction?

7. What are the equilibrium expressions,  $K_c$  and  $K_p$ , for each of the following heterogeneous reactions?

